Attic Insulation

Should You Insulate?

Heat loss from leakage elsewhere in the home or from conduction through uninsulated basement walls is more significant than ceiling loss. If the basement walls are insulated and caulking and weatherstripping has been applied to windows and doors and other leakage areas, improving the attic's insulation and air tightness is the next step.

How do you decide if the attic needs to be insulated? If the present insulation value is low or if the house is uncomfortable and drafty, adding insulation will be practical and sensible.

This will help you decide -- whether you plan to do it yourself or contract the job.

In an average Alberta home, 15 to 20 per cent of the total heat can be lost into the attic through the ceiling.

One-half of that heat is lost by conduction, which is heat flow right through the present insulation. The other half of the heat is lost because of warm air leakage through tiny holes or cracks around recessed light fixtures, ceiling electrical boxes, the chimney, plumbing stacks, attic hatch and other openings into the attic space. The combined air leakage and conduction heat loss may be costing $100 a year.

Heat loss cannot be reduced to zero. Heat energy will always move through the ceiling materials but you can reduce the heat loss to an acceptable level.

How Much Insulation is Reasonable?

A reasonable ceiling insulation level is the Alberta Building Code minimum standard RSI value of 6 (R 34). The RSI value (R value) refers to the resistance to heat flow--the higher the better. If the present insulation level is close to the recommended value -- at least over RSI 4 (R 20) -- conduction heat loss reduction will be small.

When adequate insulation is in place, significant heat loss reductions can be achieved by reducing air leakage through cracks and holes.

Reducing the leakage by two-thirds can save $20 to $30 a year in energy costs. If the ceiling has minimum insulation and is upgraded to RSI 6 (R 34), and air leaks are sealed, total savings could be $40 to $60 a year. The payback period depends on the cost of the improvement, the reduction in heat loss and the cost of fuel. (Payback is defined as the cost of an improvement divided by the first year's energy saving.)

Figure 1 shows the types of attics and ceilings discussed here. For detailed information on one-and-a-half storey homes see *Storey-and-a-Half Insulation*. Most Alberta homes are in these categories.

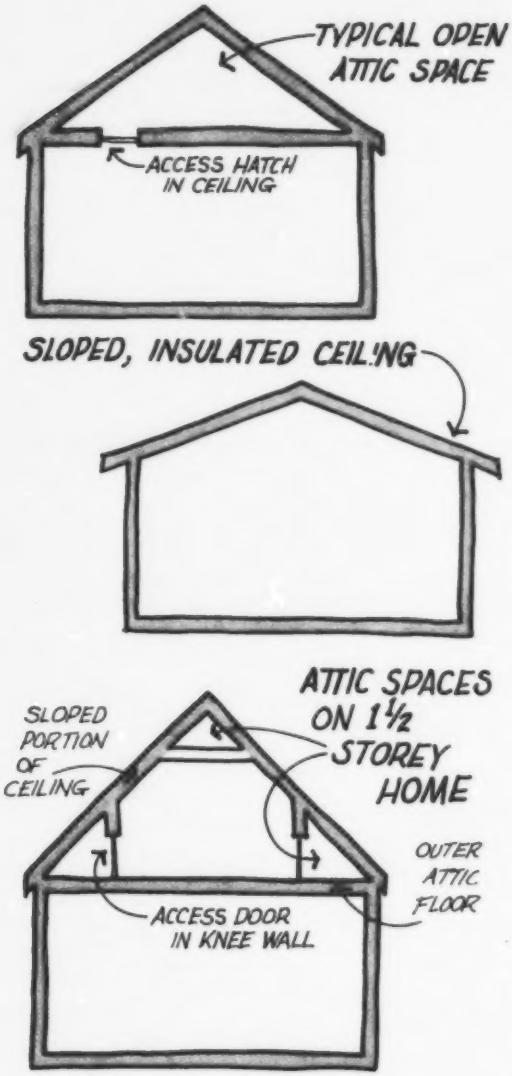
TYPICAL OPEN ATTIC SPACE
ACCESS HATCH IN CEILING
SLOPED, INSULATED CEILING
ATTIC SPACES ON 1½ STOREY HOME
SLOPED PORTION OF CEILING
OUTER ATTIC FLOOR
ACCESS DOOR IN KNEE WALL

Figure 1

Improvements to air tightness and insulation levels will save energy and heat will be more evenly distributed, drafts reduced and comfort increased. The house should also be cooler in the summer.

Checking Your Attic

Most attic spaces have access doors or hatches, often located in closets or hallways. It may be necessary to drill holes in closet ceilings or in other out-of-the-way places to check the condition of the insulation and vapour barrier in homes with a sloped, open-beam ceiling.

When working in the attic space, take care to stay on the ceiling joists or use planks as a platform. Use a large flashlight. You may wish to wear gloves and a mask. (Figure 2).

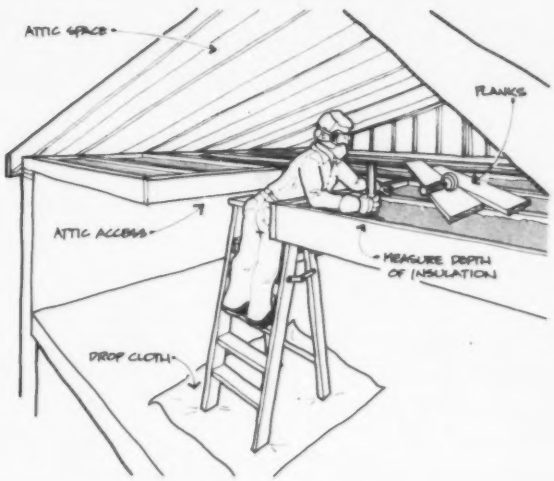

Figure 2

With a ruler measure the depth of the present insulation. Use the RSI value (R value) shown in Table 1 as a guide to calculate the total insulation value. If you have difficulty identifying the insulation type, show some to a knowledgeable neighbour or to a local building supply outlet for help or call the Energy Matters line at Zenith 22339 (427-5300 in Edmonton).

Check the condition of the vapour barrier. This can be a thin polyethylene sheet applied between the joists and the ceiling finish or may be tar paper attached to batt insulation. Scrape away a bit of insulation to see if a vapour barrier exists. If it does, spot check for cuts or rips. In older homes you may not find a vapour barrier. Check around electrical fixture outlet boxes, chimney and plumbing stacks to see if there are gaps where air leakage can occur. Replace the insulation in these areas before leaving the attic space.

Shine the flashlight around the attic and examine the evenness of the insulation layer. Are there bare spots or piles of material? Look for moisture damage -- wet insulation, compacted insulation or water stains on rafters, joists or roof sheathing. If moisture problems are the result of a leaky roof, repairs must be made before adding insulation. (Check the roof from the attic during a rain storm to pinpoint where it is leaking.) Severe hail damage, poorly installed vents or mechanical damage affect roof performance. Age can be a factor. Asphalt shingles, for example, have a life expectancy of 15 to 20 years.

Moisture problems can also be caused by inadequate attic ventilation or severe air leakage into the attic space. These are covered in more detail later.

If the insulation in the attic space is in good condition -- evenly distributed, dry and not settled -- more insulation can readily be added. **Remember to seal the air leaks first.**

Guide to Types of Insulation

Choosing insulation or checking the condition of existing insulation is difficult without some knowledge of the characteristics of each type of material. Table 1 helps do both.

All the insulation materials listed in Table 1 are acceptable for use under the Alberta Building Code. Further stringent standards have been established by the Canadian General Standards Board. The standards give the assurance that the insulation material will perform well when applied properly. It is important to ensure the insulation material is applied at its proper density to get the correct RSI/R value.

A concern with all materials is to keep insulation clear of heat sources that are a potential fire hazard. For example, the Alberta Building Code requires a two-inch clearance around a chimney.

When choosing an insulation material consider its RSI/R value, ease of application, specific application requirements, availability, weight and cost.

Before Insulating

Should You Hire a Contractor?

Improving the insulation and air tightness of the attic or ceiling is within the skills of the average handy person. However, it is not a pleasant job. While not physically demanding, it can be messy and is often done in cramped quarters. Adding ventilation can require working on ladders or the roof surface. In small attic spaces where insulation must be blown in, little cost will be saved by the do-it-yourselfer.

The decision to hire a contractor may be the only option if you cannot do the work. Consider:

- Try to gather names of contractors from friends and neighbours who have had insulation installed. Ask if they were pleased (make sure they actually checked the job). If unsuccessful, use the Yellow Pages.
- Verify the knowledge level of the contractor by asking questions about R-value, different insulation types, sealing techniques and ventilation. (Base your questions on knowledge gained from articles and publications like this.)
- Get at least three detailed cost estimates from different contractors -- suspect any that vary widely for an equivalent job. (Remember, it is worth paying a little extra for a proper air-sealing job.)
- Details on the contract should include total price, plus a labour and material breakdown, type of insulation and appropriate government standards to which it conforms, thickness and value of insulation, size of areas to be insulated, areas to be sealed and type of materials used, and a statement of ventilation requirements including any necessary vents.
- Before selecting a contractor, check that the firm is bonded, has a provincial licence and is adequately insured. Find out how long the firm has been in business by calling the Better Business Bureau.

No amount of advice will ensure a perfect insulation job but following these steps will increase the chances of getting an acceptable one. Inspect the job before the contractor leaves and before making final payment. Make sure the specifications with regard to insulation type, quantity and quality have been met. If possible, be at home to count the number of bags of insulation actually used. Check that any air-sealing was completed and the ventilation requirements have been satisfied (Table 2). Remember, asking the right questions at the right time will ensure a better-than-average job.

Table 1

Common Types of Attic Insulation

Material	Description	Insulation Value[1]	General Comments
Cellulose fibre blown	Finely milled newsprint chemically treated to resist fire and fungal growth	RSI 2.5/100 mm (R 3.6/inch)	• Fills irregular horizontal spaces • A blown-in type that can be installed with rented equipment or hand-poured using manufacturer's recommendations • Should not be covered with heavier types of insulation which may compress it • Will settle too much if not blown properly • Additives provide fire, corrosion, vermin and fungal resistance • Slight moisture has little effect on R-value
Glass fibre batts	Glass spun into long fibre, woven, coated with a binder then cured Uniform widths, lengths and thicknesses available	RSI 2.2/100 mm (R 3.2/inch)	• Fits best into standard joist and stud spaces • Does not fit readily into irregular spaces • Fire resistant • Eye, skin, respiratory irritant at installation • Slight moisture has little effect on R-value
Glass fibre blown	As above but cut into small pieces	RSI 1.9/100 mm (R 2.7/inch)	• Fills irregular horizontal spaces • Will settle if not blown properly • Lightest loose-fill insulation • Should not be covered with heavier types of insulation which compress it • Fire resistant • Slight moisture has little effect on R-value • Eye, skin, respiratory irritant at installation
Mineral or rock wool blown	Mineral: industrial slag melted, fibrized and annealed with a fine film of oil Rock: Natural rock, melted fibrized and bonded with oil and binders	RSI 1.9/100 mm (R 2.7/inch) RSI 1.9/100 mm (R 2.7/inch)	• Fills irregular horizontal spaces • Should not be covered with heavier types of insulation which may compress it • Will settle if not blown properly • High fire resistance • Slight moisture has little effect on R-value • Eye, skin, respiratory irritant at installation
Rigid board	Various types include: expanded polystyrene; extruded polystyrene; glass fibre board;and polyurethane Uniform widths, lengths and thicknesses available	RSI value ranges from 2.5 to 4.2/100 mm (R 3.6 to 6.0/inch) depending on type	• Can be installed interior or exterior where little or no space is available (cathedral ceiling, flat roof) • Lightweight • Some types are a fire hazard unless properly covered with a thermal barrier on room side; 12.7 mm (½ inch) gypsum board or equivalent • Some types must be protected from sunlight
Vermiculite[2]	Expanded Palabora vermiculite ore	RSI 1.6/100 mm (R 2.3/inch)	• Easy to pour in irregular spaces • Dries very slowly after absorbing moisture • Non-combustible • Non-abrasive, non-corroding, odourless and non-irritating
Wood shavings	Wood shavings often mixed with lime or other chemicals	RSI 1.7/100 mm (R 2.5/inch)	• Dries very slowly after absorbing any moisture • May settle • Hard to treat against fire, vermin and fungus growth

Notes: **All insulation materials must be kept clear of any heat source (chimney, recessed lights, etc.) to avoid potential fire hazard (see Figures 4, 5 and 9).**

Although the weight of insulation materials should have no effect on the existing ceiling, it is recommended that weak areas be strengthened before the attic is insulated.

1 Use these values for existing insulation only. For new insulation use the manufacturers' specifications.

2 Product is no longer manufactured for use in attics.

Doing the Job Yourself

Safety

If you do the job of upgrading your attic insulation and airtightness, make sure safety is uppermost in your mind. Use ladders correctly -- support them properly and have a helper steady them. Use a safety rope tied to a secure place when working on the roof. In the attic space, wear long sleeves with tight-fitting cuffs, gloves and a hat to keep insulation materials from irritating exposed skin. Use a dust mask and goggles (available at building supply outlets) because most insulation materials are dusty and may cause skin, eye and respiratory irritation while you are working with them.

The attic can be hot during the summer. Work on cool spring or fall days or on cool summer evenings. Make sure any temporary lighting such as a trouble lamp is securely fastened to rafters. Never use candles or matches near dusty insulation materials. And, it goes without saying, never smoke on the job!

Permits

Minor renovations such as upgrading the insulation are usually classed as "improvements" and a building permit may not be required. An electrical permit will be needed if any alterations are made to ceiling wiring -- removing recessed lights or repositioning outlets, for example.

Tools for the Job

Depending on the complexity of the attic insulation and sealing job, the material used, and the type of attic, the following may be required:

- extension or step ladders to gain access to the attic or roof
- temporary lighting using trouble lamps
- scaffolding when working on the interior of open beam ceilings
- planks for support in attic spaces
- utility knife, heavy polyethylene, stapler, tape and caulking materials for plugging air leaks, repairing the vapour barrier and installing insulation stops
- tape measure, square, hammer, saw, drill, nails and screws for installing new vents
- rake or board for spreading loose-fill insulation evenly
- rented blowing machine and helper, if using blown-in cellulose fibre insulation

And don't forget personal safety items like goggles, dust mask, gloves and hard hat.

Preparing the Attic Space

Background

In a normally heated space warm air tries to rise through the ceiling. No matter how well the ceiling is built, some air will get out through any tiny crack or hole it can find. Warm air carries moisture with it. As leaking warm air reaches the cooler temperature in the attic, water vapour condenses into droplets on the nearest cool surface. (It forms ice directly if the temperature is cold enough.)

Condensation occurs when moist warm air meets a cold surface. Vapour must be removed from the places where it condenses, such as in the insulation or on the roof trusses, or moisture accumulation results.

Proper ventilation ensures that the vapour is gradually carried out before further moisture or ice accumulation occurs. Air moving from the soffit or gable vents picks up the vapour and carries it outside through gable or ridge vents near the roof peak. In cold weather some frost deposits on the underside of the roof may be visible because the outside air is near saturation and cannot remove much water vapour. As the weather warms, this ice gradually changes into water vapour and is removed, if the ventilation is adequate.

The greater the insulation level in the attic, the more likely condensation will take place. Air leaking through the increased insulation will be colder and less able to hold the moisture. Therefore, ventilation is more important when insulation is added and stopping air leakage at the ceiling level also becomes critical.

First: Control the Air Leakage

A polyethylene vapour barrier is used to stop the movement of water vapour into the insulation of floors, walls and ceilings. Because it also stops air movement it is commonly referred to as the air/vapour barrier. This barrier must be placed at or near the warm side.

In a typical ceiling there are many "breaks" in the air/vapour barrier. The attic hatch, plumbing stacks, partition walls, recessed lights, bathroom fans and chimneys all penetrate the layer. Many older homes do not have an air/vapour barrier. Controlling air leakage involves plugging all the holes you can find plus improving the air/vapour barrier. More information on types and applications of caulking and weatherstripping materials is in *Caulking and Weatherstripping*. Controlling air leakage is a two-part problem.

Improving the Air/Vapour Barrier

When there is no ceiling air/vapour barrier, the simplest solution is to paint the inside surface with semi-gloss latex or vapour barrier paint. Make sure the space is well-ventilated.

A new air/vapour barrier can be added to a ceiling without one. Heavy polyethylene strips can be cut from 0.150mm (6 mil) material and placed between the ceiling joists from above (Figure 3). These are sealed to the joist with a non-hardening material such as acoustical sealant or solvent-based acrylic caulking. This labour-intensive method works best when there is no existing insulation to be moved aside. Adding a new air/vapour barrier helps plug some air leakage in the attic but many other problem areas may remain.

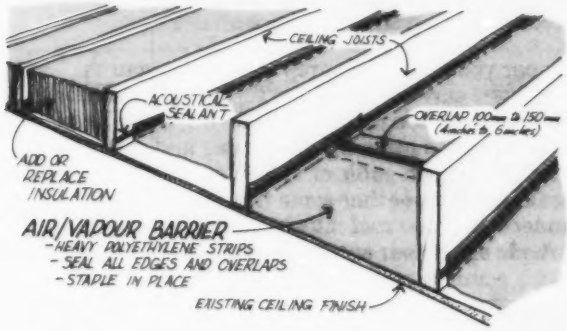
CEILING JOISTS
ACOUSTICAL SEALANT
OVERLAP 100mm to 150mm (4 inches to 6 inches)
ADD OR REPLACE INSULATION
AIR/VAPOUR BARRIER
- HEAVY POLYETHYLENE STRIPS
- SEAL ALL EDGES AND OVERLAPS
- STAPLE IN PLACE
EXISTING CEILING FINISH

Figure 3

Sealing the Holes

- around plumbing stacks and kitchen and bathroom exhaust ducts
- through recessed lights, electrical boxes and wiring framing holes
- along the top plates of interior and exterior partitions
- around chimneys
- past attic hatches or access doors

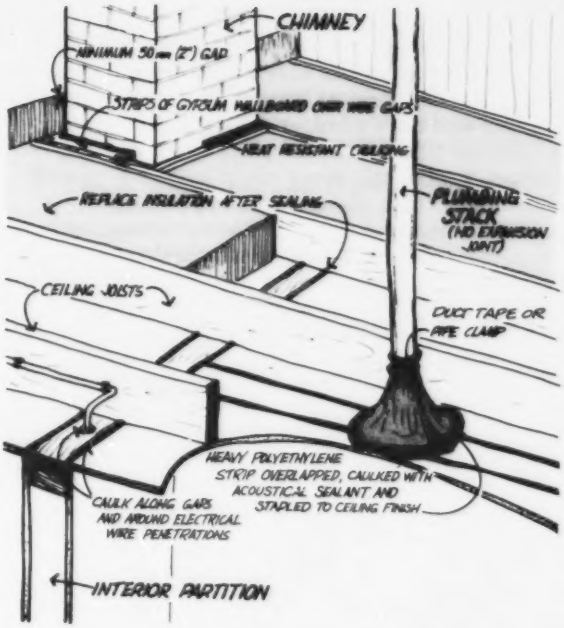
CHIMNEY
MINIMUM 50mm (2") GAP
STRIPS OF GYPSUM WALLBOARD OVER WIRE GAPS
HEAT RESISTANT CEILING
REPLACE INSULATION AFTER SEALING
PLUMBING STACK (NO EXPANSION JOINT)
CEILING JOISTS
DUCT TAPE OR PIPE CLAMP
HEAVY POLYETHYLENE STRIP OVERLAPPED, CAULKED WITH ACOUSTICAL SEALANT AND STAPLED TO CEILING FINISH
CAULK ALONG GAPS AND AROUND ELECTRICAL WIRE PENETRATIONS
INTERIOR PARTITION

Figure 4

Metal plumbing stacks and exhaust ducts are difficult to seal because they expand and contract as warm air or water flows through them. The best solution with stacks which have no expansion joint built in is a flexible seal (Figure 4). Heavy polyethylene, a clamp or duct tape, sealant and staples are used to attach a collar which allows movement yet maintains the seal. Plumbing stacks which have expansion joints can be secured and sealed at the ceiling surface (Figure 5). As well as being sealed to the ceiling air/vapour barrier, exhaust ducts must be insulated where they pass through the attic space. If not, moisture condenses on the cold duct surface in the attic, then melts and drips off each time warm air is exhausted.

Breaks in the air/vapour barrier caused by electrical outlet boxes and wiring penetrating the ceiling can be plugged with caulking and pieces of heavy polyethylene (Figure 5). (Recessed lights are different and illustrated in Figure 9.)

Caulking can be used to seal any gaps along the tops of interior or exterior wall plates (Figure 4). Use a polyurethane foam for gaps that are over 12mm (1/2 inch) in width. Some gaps will have been covered if a new air/vapour barrier was installed.

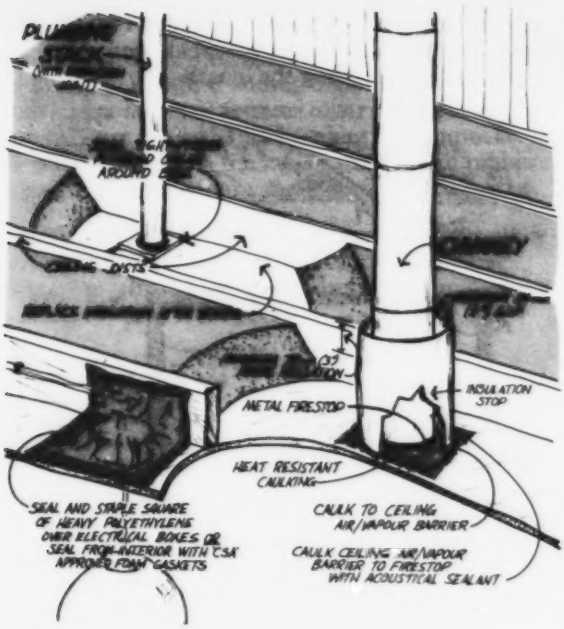
METAL FIRESTOP
INSULATION STOP
HEAT RESISTANT CAULKING
SEAL AND STAPLE SQUARE OF HEAVY POLYETHYLENE OVER ELECTRICAL BOXES OR SEAL FROM INTERIOR WITH C.S.A. APPROVED FOAM GASKETS
CAULK TO CEILING AIR/VAPOUR BARRIER
CAULK CEILING AIR/VAPOUR BARRIER TO FIRESTOP WITH ACOUSTICAL SEALANT

Figure 5

Sealing around chimneys is done in one of the two ways shown in Figures 4 and 5. **It is important to use heat-resistant caulking like muffler cement and metal or gypsum wallboard backing close to sources of high heat.** Polyethylene cannot be attached or sealed to chimneys. The insulation must be kept at least 50mm (2 inches) from the chimney surface. Batt insulation can be cut accurately to give the required clearance. A metal or gypsum wallboard barrier (Figure 5) should be used with loose-fill insulation.

The attic hatch is a door to the attic space. It must be insulated and weatherstripped (Figure 6). Stopping air leakage around the edge is as important as insulating it. If upgrading the insulation levels in the attic space, blocking should be added around the opening to keep loose-fill material from falling on to the hatch. Insulate it with glued-on rigid materials or fibreglass batts (held in place with cotton or burlap) to an insulation value equal to that in the attic.

If doing extensive renovations, consider closing the interior hatch and replacing it with one on an exterior gable end. It is just as convenient and removes a major source of air leakage.

Table 2

Ventilation Requirements

	Ratio: Ventilation Area/Ceiling Area		
	Ceiling with Air/Vapour Barrier		Ceiling with no Air/Vapour Barrier
Type of Vent	Steep Slope Roof (over 1 in 6)	Moderate Slope Roof (under 1 in 6)	
Unobstructed opening	1:300	1:150	1:150
Screened opening			
3 mm (⅛")	1:270	1:135	1:135
1.5 mm (1/16")	1:220	1:110	1:110
Screened and louvred opening			
3 mm (⅛")	1:220	1:110	1:110
1.5 mm (1/16")	1:200	1:100	1:100

Examples: A 112-square metre home with an air/vapour barrier in place and roof slope over 1 in 6 would require (112 divided by 270) 0.4 square metre of 3 mm screened vent.

A 900-squre foot home with no air/vapour barrier would need (900 divided by 110) 8.2 square feet of ⅛ inch screened, louvred vent.

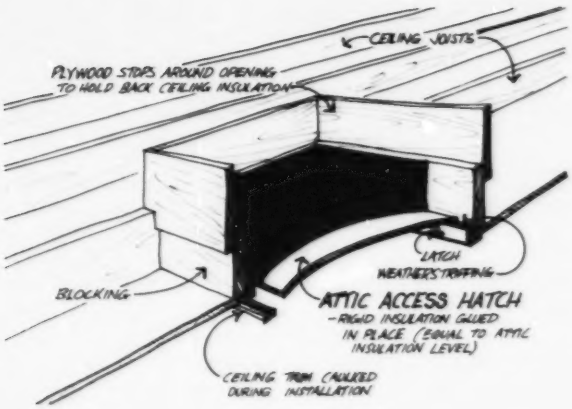
CEILING JOISTS
PLYWOOD STOPS AROUND OPENING TO HOLD BACK CEILING INSULATION
LATCH
WEATHERSTRIPPING
BLOCKING
ATTIC ACCESS HATCH
- RIGID INSULATION GLUED IN PLACE (EQUAL TO ATTIC INSULATION LEVEL)
CEILING TRIM CAULKED DURING INSTALLATION

Figure 6

Second: Ensure Adequate Ventilation

As mentioned, attic spaces require ventilation to control moisture build-up regardless of roof space or attic type. Proper ventilation ensures that the space is cooler in summer, meaning that less heat is transmitted into the house.

The amount of ventilation required is directly proportional to the building ceiling area. The correct ratio is 1:300 for unobstructed vents in a steep slope roof (Table 2). For example, if the ceiling area is 140 square metres (1500 square feet), an unobstructed ventilation area of 0.45 square metre (5 square feet) is needed. However, if there is no effective air/vapour barrier present, the ventilation ratio should be 1:150. In the example given, 0.93 square metre (10 square feet) is required for the same size home. The requirements for other vents are shown in Table 2. Obstructions to free air flow, such as screens and louvres, increase the vent size requirements.

All vents must be properly installed to prevent rain or snow penetration. They must be adequately caulked and correctly tied in to the shingle layers. Plan vent locations to avoid areas subject to prevailing high winds in winter. Snow blows into such vents and can cause water problems when it melts (ceiling stains, insulation damage, etc.).

Be cautious before installing any type of fan-powered vent. Natural ventilation will adequately exhaust air if there is sufficient area for the air to move in and out. Powered ventilators may help keep the attic space cooler in the summer but they can produce negative pressure that can draw air through cracks or holes in the ceiling. In the winter the chance of moisture damage can increase due to the higher rate of warm, moist air leakage.

If additional venting is required it can be installed as in Figure 7. Ideally, vents should provide roof cross-venting from end to end and top to bottom. Keep this in mind when installing new vents: they should be at both the eaves and peak, and distributed evenly along the length.

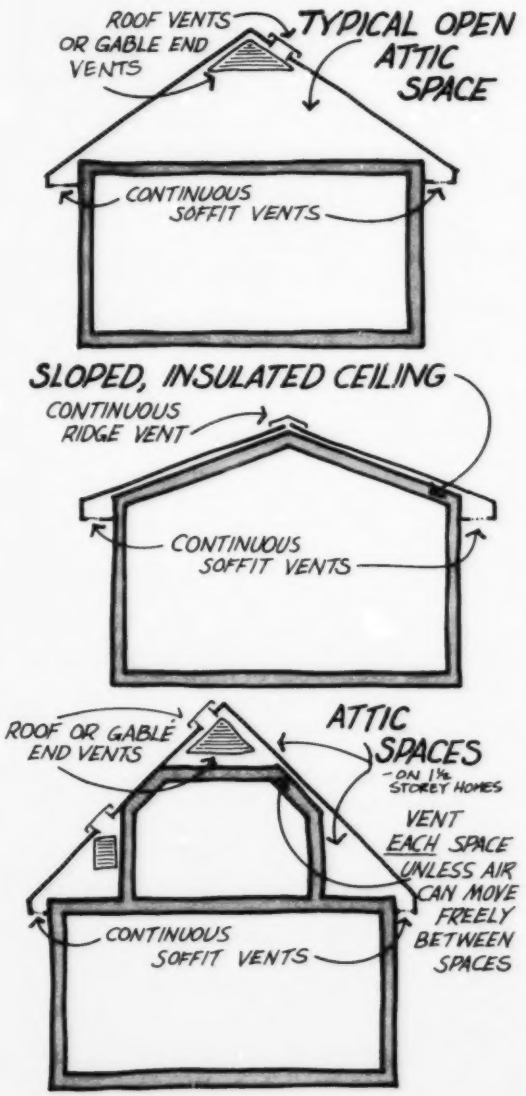
ROOF VENTS OR GABLE END VENTS
TYPICAL OPEN ATTIC SPACE
CONTINUOUS SOFFIT VENTS
SLOPED, INSULATED CEILING
CONTINUOUS RIDGE VENT
CONTINUOUS SOFFIT VENTS
ROOF OR GABLE END VENTS
ATTIC SPACES
- ON 1½ STOREY HOMES
VENT EACH SPACE UNLESS AIR CAN MOVE FREELY BETWEEN SPACES
CONTINUOUS SOFFIT VENTS

Figure 7

Different attic configurations require individual solutions, with the main concern being that all attic spaces are vented. Some one-and-a-half storey houses have two or three separate areas to vent. A combination of eave, gable end and ridge vents may be required.

Insulating the Ceiling Space

Insulating the ceiling space will complete the attic upgrading. Whether adding insulation or not, make sure as many sources of air leakage as possible are sealed. Alkyd sealers and enamels properly applied on the inside surface can replace a poor or non-existent vapour barrier in the attic.

The following illustrations and explanations show the techniques of adding insulation -- whether doing the job yourself or making sure the contractor does it properly.

Open Attic Space

An easily accessible type of attic space (Figure 1, top) can be insulated using batt or loose-fill insulation products. It is important to extend the added insulation, regardless of the type, as far into the eave as possible (over the wall below), being careful not block the path of air from vents. Plywood, waxed cardboard or plastic insulation stops should be installed between the rafters to keep insulation off the soffit (Figure 8). These are available where insulation materials are sold.

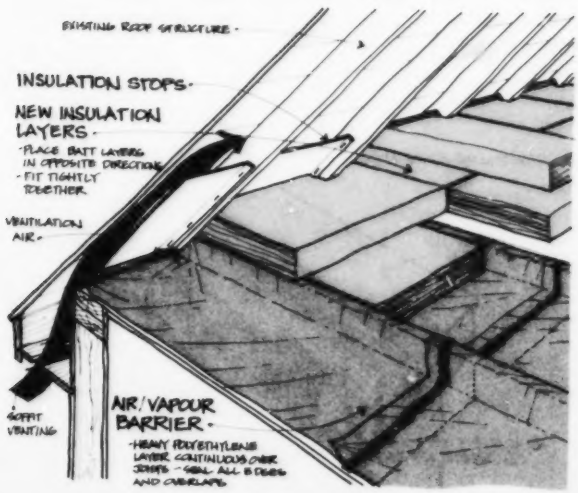

Figure 8

Loose-fill types of insulation are poured or blown into place. A rake or screed board can be used to level it. You should attach markers at various points to indicate the depth above the ceiling joists to maintain a uniform thickness. (These can be pieces of lath or string hung from the rafters.) Be careful not to damage the air/vapour barrier when working.

Batt insulation can be installed using a continuous air/vapour barrier when there is no insulation or vapour barrier in place (Figure 8). Continuous sheets of heavy polyethylene are draped over and between the ceiling joists. The joist cavities must be clean and the polyethylene fitted snugly into the spaces. The batts should also be fitted snugly together -- two or three layers placed in opposite directions with no gaps between. Be sure to cut accurately around obstructions (chimneys, stacks, supports, etc.).

Insulation must not be placed closer than 50mm (2 inches) to chimneys (Figures 4 and 5). Recessed lights must have an adequate air space around them. Figure 9 is the preferred method of sealing and insulating around them. The most-efficient solution is to replace them with standard ceiling fixtures.

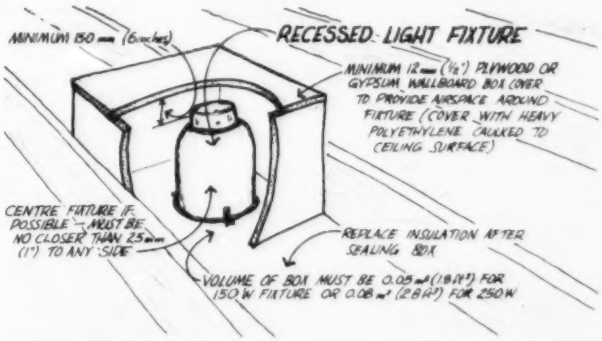
RECESSED LIGHT FIXTURE
MINIMUM 12 mm (½") PLYWOOD OR GYPSUM WALLBOARD BOX COVER TO PROVIDE AIRSPACE AROUND FIXTURE (COVER WITH HEAVY POLYETHYLENE CAULKED TO CEILING SURFACE)
CENTRE FIXTURE IF POSSIBLE - MUST BE NO CLOSER THAN 25 mm (1") TO ANY SIDE
REPLACE INSULATION AFTER SEALING BOX
VOLUME OF BOX MUST BE 0.03 m³ (1 ft³) FOR 150 W FIXTURE OR 0.08 m³ (2.8 ft³) FOR 250 W

Figure 9

One-and-a-half Storey Attic Space

The type of attic shown, (Figure 1, bottom) presents a combination of flat and sloped ceilings, as well as walls, which need to be sealed and insulated. The flat attic ceiling can be treated as an open attic space (page 8), particularly if there is room to work. If space is limited, blowing loose-fill insulation in may be the only possibility. For more detailed information, phone Energy Matters (Zenith 22339 or 427-5300 in Edmonton) and ask for *Storey-and-a-Half Insulation*.

The outer attic floor and short support walls (called knee walls) can usually be reached through doors in closets or hallways. An air/vapour barrier should be installed (if one is not present), then batt or a combination of batt and loose-fill insulations added (Figure 10). This wall should be insulated to the depth of the studs. Make sure the batts stay in place against the wall -- stapled building paper may be needed to hold them. The outer attic floor (the ceiling of the space below) should be insulated to about RSI 6 (R 34).

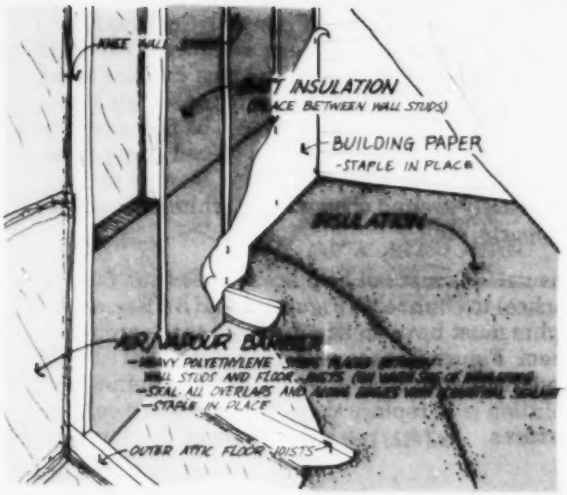

Figure 10

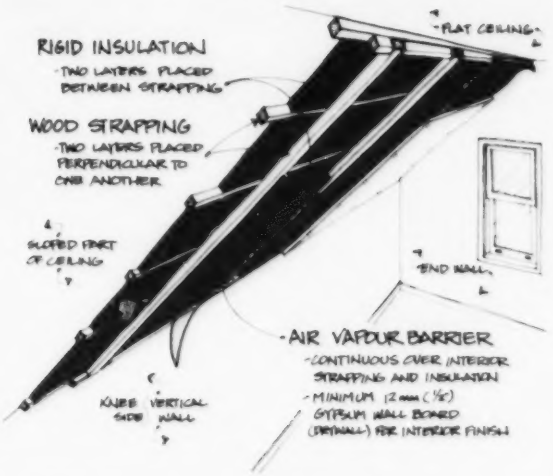

Figure 11

Sloped Ceiling

In addition to the interior ceiling-upgrading method (Figure 11) the exterior of a sloped ceiling can be insulated instead (Figure 12). This is the only solution for an open beam ceiling to retain the interior finish -- exposed wood beams, for example. The high cost means it should be considered only when re-roofing.

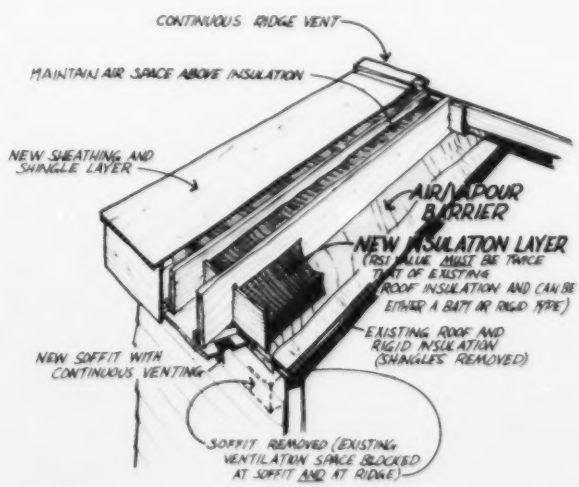
CONTINUOUS RIDGE VENT
MAINTAIN AIR SPACE ABOVE INSULATION
NEW SHEATHING AND SHINGLE LAYER
AIR/VAPOUR BARRIER
NEW INSULATION LAYER
(RSI VALUE MUST BE TWICE THAT OF EXISTING ROOF INSULATION AND CAN BE EITHER A BATT OR RIGID TYPE)
EXISTING ROOF AND RIGID INSULATION (SHINGLES REMOVED)
NEW SOFFIT WITH CONTINUOUS VENTING
SOFFIT REMOVED (EXISTING VENTILATION SPACE BLOCKED AT SOFFIT AND AT RIDGE)

Figure 12

The sloped ceiling represents the greatest challenge to insulate and seal. A semi-gloss latex or vapour barrier paint is probably the easiest method to provide the vapour barrier. Insulation is then placed into the roof cavity (if access is possible from above or below). An air space of 75mm (3 inches) should be left above the insulation to allow adequate ventilation. Rigid glass fibre insulation can be cut accurately and slid into the rafter spaces. Often, the rafters are only 89mm wide (a 2x4 on edge), which means an RSI value of just 2.1 (R 12) can be attained without plugging the space completely.

An alternative method that allows for higher insulation levels is to strap the sloped sections on the inside (Figure 11), adding rigid insulation and a new air/vapour barrier as shown. Two layers of strapping at right angles can be used to get a higher level of insulation. This method can be carried down the knee walls and over the ceiling if access into the attic or wall spaces is difficult.

Two strapping layers placed at right angles help eliminate "thermal bridges" through solid wood studs. (Wood has a lower resistance to heat flow than insulation.) This technique can also apply to open-beam or cathedral ceilings, but the existing ceiling finish will be covered over. **With this method the air/vapour barrier must be punctured** (two or three times in each joist space), as it is now on the cold side of the new insulation layer. If foamed plastic insulation is used it must be covered with a minimum of 12mm (1/2 inch) thickness of gypsum wallboard.

If the present air/vapour barrier is not in good condition a new one can be placed over the roof as shown. Ventilation in the existing structure must be blocked and provision made for adequate ventilation above the new insulation layer -- usually with continuous soffit and ridge vents.

This method can also be applied to a one-and-a-half storey home that has little insulation in place. It is one solution to the problem of covering all the jogs, angles and small spaces.

Summary

- Seal air leaks in the house and insulate the basement before considering attic insulation.
- Check insulation levels and the condition of the air/vapour barrier.
- Decide whether to do it yourself or hire a contractor.
- Decide which materials to use and which tools are required.
- Check attic ventilation (install more if required).
- Eliminate air leakage (even if not insulating).
- Add insulation (be careful around heat sources, do not plug vents).
- If you hire a contractor, check the job before paying.
- Insulate and seal attic hatch.

The benefits of attic upgrading include savings of energy and money and improved comfort in both summer and winter.

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